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ZOOGOER

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Volume 14, Number 1

Friends of the National Zoo is a nonprofit organization of individuals and families who are interested in supporting Zoo programs in education, research, and conservation. As members of FONZ, you and your family receive many benefits—publications, discount privileges, and invitations to special programs and activities to make your zoogoing more enjoyable and educational.

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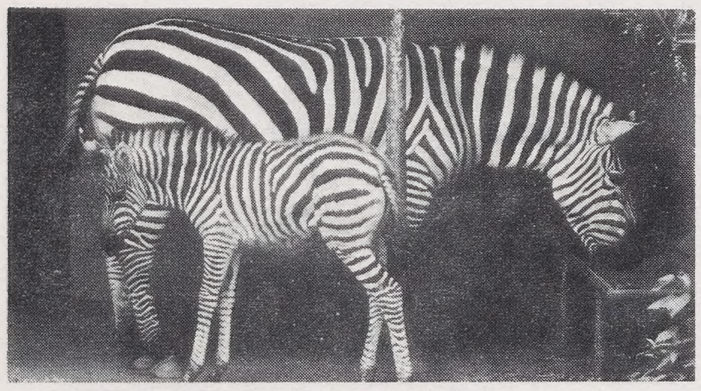
Cover Photos

The striking pattern of a zebra's stripes has very practical uses in the wild (page 4). Back cover: A feisty Cuban crocodile emerges from its egg in the National Zoo's first hatching of this rare species (page 20). Cover photos by Jessie Cohen, NZP Office of Graphics and Exhibits.

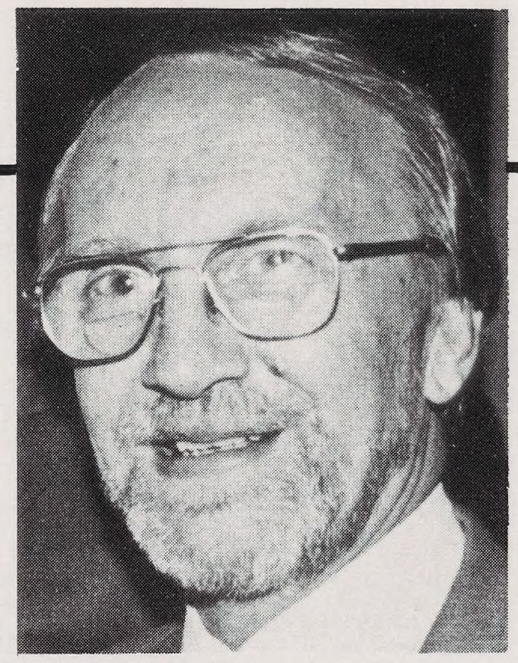


Contents

Correction

Boy are we turkeys! Our 1985 calendar gives FONZ members *two* Thanksgivings—the correct one, on November 28, and the one we mistakenly listed as November 21. So please change your 1985 *ZooGoer* calendar date for Thanksgiving—unless you want to celebrate it twice! And pardon us for laying such a (turkey) egg.

FONZ IN 1984: A GOLD MEDAL YEAR



Dear FONZ Member,

Like our Olympic athletes, FONZ walked off with a lion's share of gold medals in 1984. Here are just a few winning performances by your FONZ team last year.

- A record 600 volunteers contributed an incredible 50,000 hours to operate 20 different education programs. Ours is probably the largest volunteer museum effort in the world, and last year we launched our single largest volunteer project—the building over four busy days of outdoor exercise furniture for the giant pandas. That effort not only combined volunteers and staff of FONZ and NZP, but also successfully obtained contributions of money, tools, materials and food from many businesses including the special gift of all 150 custom-cut logs used which were donated by Weyerhaeuser Corp., then transported across country free by Consolidated Freightways.

- An expanding membership has meant that dues and contributions more than doubled over any previous year in our history. To serve our 50,000 members, we offered more classes, trips and special activities than ever before; your *Wildlife Adventures* newsletter was redesigned; our new Safari Club grew to 250 members; and we launched a dramatically improved and color-filled *ZooGoer* magazine, which won a publishing award.

- Thanks to able staffers in our food, shop and parking operations, FONZ broke new revenue records in 1984 while continuing to provide quality and convenient services to Zoo visitors.

- Increased revenues produced record-high FONZ funding of some 50 NZP-sponsored research and conservation projects—such as the pioneering project to reintroduce golden lion tamarins to their native Brazilian habitat; training programs for wildlife professionals from the animal-rich countries in Asia, Africa and South America; and a series of public symposia on crucial wildlife issues that won a major award from the American Association of Zoological Parks and Aquariums.

If FONZ won many gold medals in 1984, we hope to do even more in the future. Some of our exciting plans for 1985 and beyond are described on page 22. Clearly, we have come a long way in just 26 years—and we will go even further in coming years.

Sincerely,

Robert Nelson
FONZ President, 1982-1984

Masters of Deception

Dr. Michael Robinson

From lions to preying mantids, predators have developed a wide variety of attributes to help them catch other animals. Strength, speed and intelligence are common characteristics of many predators. But some have very specialized attributes such as the spider's ability to spin a "sticky" web or the anglefish's dorsal fin lure.

To escape predators, prey animals have also developed a variety of attributes—both general abilities such as running, jumping, flying or swimming, and specialized qualities such as the skunk's noxious odor or the porcupine's quills. One of the most intriguing of these attributes is visual deception—the ability of certain prey animals to escape predators through either camouflage or disguise. These remarkable forms of defense are found throughout the animal kingdom.

Camouflage

The rules of camouflage are relatively simple: The animal must not be recognizable by the predator. It should not move and give its presence away, and it should blend into its background so that its shape does not reveal its identity.

The simplest form of camouflage is color matching. Green insects rest on green leaves and brown ones rest on brown leaves. This often works but is a bit restrictive.

A step beyond this is to change color to match the background. Squids and cuttlefish can change color instantly, and some insects can do it within a few minutes.

Mammals and birds whose color depends on their fur or feathers can only change color slowly. Some mammals, such as weasels and hares, and certain birds, like the ptarmigan, shed their summer fur or feathers to become winter white. But for several weeks during their color change, they are either light when they should be dark, or vice versa.

Often, color matching is not good enough. Even a white hare in the snow shows a conspicuous outline when it casts a shadow. So camouflaged animals have evolved outline-concealing devices that include countershading and disruptive patterning.

Countershading helps conceal the effects of highlight and shadow: Light bellies help cancel out dark shadows under the animal; darker backs cancel out light reflection from above. Most camouflaged animals are darker on top than underneath, but the upside-down catfish, which swims belly-up to feed on algae, has a dark ventral surface and light back.

Disruptive patterning uses stripes and blotches to destroy outline. Some tropical spiders that live on tree trunks are perfect examples of disruptive coloration; zebras, tigers, leopards, angelfish and most moths use disruptive patterning to hide from predators or prey. People use disruptive patterning to camouflage military equipment and soldiers.

But all that looks like camouflage is not necessarily simply for concealment. Studies suggest that the stripes of zebras also protect them from flies—by confusing rather than concealing.

Does camouflage work? Several recent experiments prove it does. Studies have shown that grey moths are easily seen and eaten by birds when they rest on soot-blackened urban trees, whereas black moths are much safer. Human smoke pollution, therefore, has resulted in the evolution of black as a camouflage color. In other studies, the blotched and spotted eggs of gulls have proved to be several times safer from crows than are white hens' eggs of similar size.

Disguise

In addition to camouflage, animals use a number of other visual protective devices. One is disguise or mimicry. If an animal can look like something that is normally inedible to predators, it may be seen but ignored. This is not the same as camouflage, which relies on concealment. To use a military analogy, camouflaging an airplane would involve

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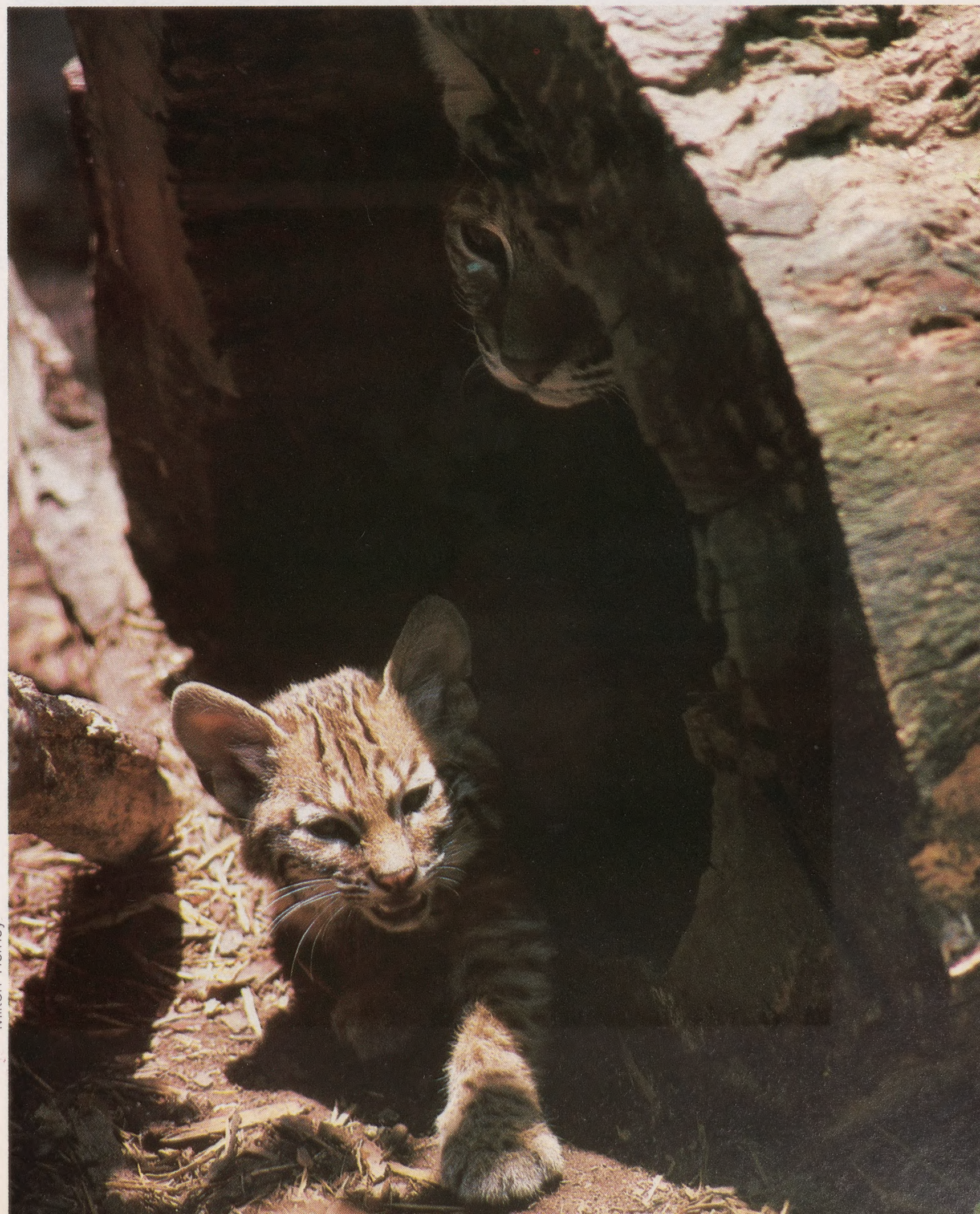
NZP Director Michael Robinson has recently completed a study of camouflage and deceptive coloration in predator-prey interactions.

making it inconspicuous against a chosen background; disguising it would involve making it look like a perfectly conspicuous but innocent object. In one case, it would be painted green and brown; in the other, it might be made to look like a haystack.

Some animals have developed elaborate disguises that make them look like inanimate objects such as leaves, sticks, thorns or bird droppings. Such mimicry is mainly found in insects; there are some examples in vertebrates, but these are mostly confined to fishes. Why? There is no simple answer. Mimicry often involves a biologically expensive process of using energy to grow and maintain elaborate body structures that are useful only as disguise. But it is clear that leaf and stick disguises, though expensive, work well and confer considerable freedom on their owners, who are protected irrespective of background so they don't have to expend energy moving onto an appropriate color.

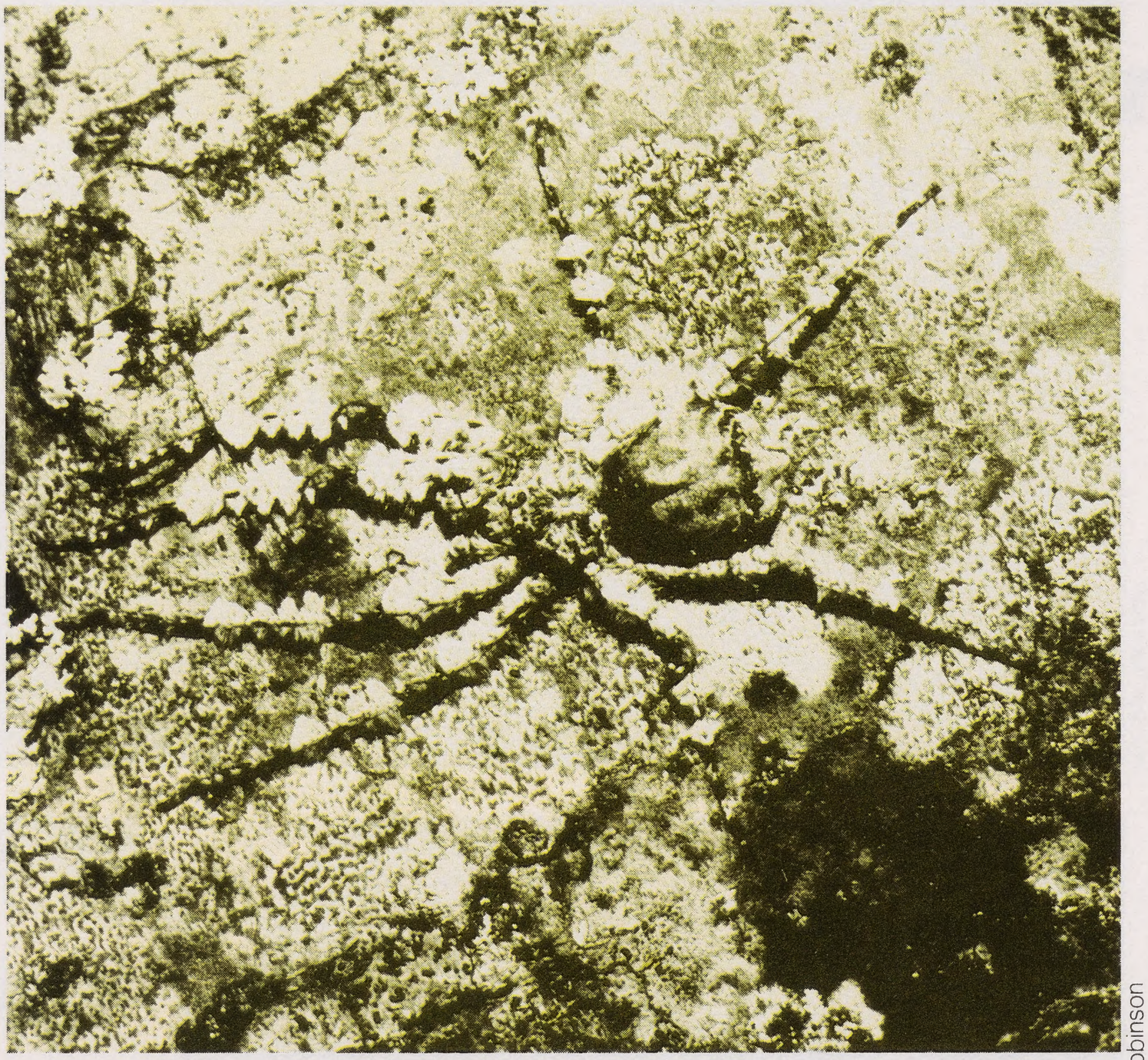
One problem with mimicry of inedible objects is that the animal cannot afford to retain any remnant of its true nature. This means it may need complex devices to conceal its legs, head and other parts. Experiments have shown that predators of insects can detect such tiny clues as an insect's head or legs. When a cricket's legs were glued onto a dry stick, small monkeys seized and bit the stick as though it were an insect. Sophisticated predators either know or learn that leaves do not have heads, legs or antennae; so leaf and stick mimics must have structures and behaviors that

Michael Robinson



Milton Tierney

Above: The leaf insect (Phyllium) *mimics foliage to deceive predators. Right: Bobcats are camouflaged to blend with dry grasses, bare ground and tree trunks.*



Michael Robinson

conceal their telltale animal parts.

Another kind of disguise is to mimic other animals' warning coloration—the conspicuous color patterns of animals that have defensive weapons such as poisonous bites, foul odors or other noxious properties. Skunks are warning-colored, advertising themselves in black and white coats; wasps have warning colors of yellow and black; poisonous coral snakes are striped red, yellow and black. These colors make it easy for predators to learn by dreadful experience and avoid familiar warning coloration: "Once bitten, twice shy."

This system works so well that it has given rise to widespread cheating. A whole range of animals imitate warning-colored models. These mimics include false coral snakes, colored like real ones but with no poison, and several insects that mimic wasps and bees but have no stings—such as flies, beetles and katydids. However, few birds or mammals work this particular trick.

Evolutionary Arms Race

Visually operating defenses are also interesting in what they tell us about the discriminatory powers of predators. Since no defense is completely effective, the animal world is always in the state of an evolutionary arms race. Each new defense evokes a new response from some predator.

One such response may be the predator's ability to detect bilateral symmetry. Bilateral symmetry is typical of animals but not of plants or inanimate objects. There is an intriguing possibility that

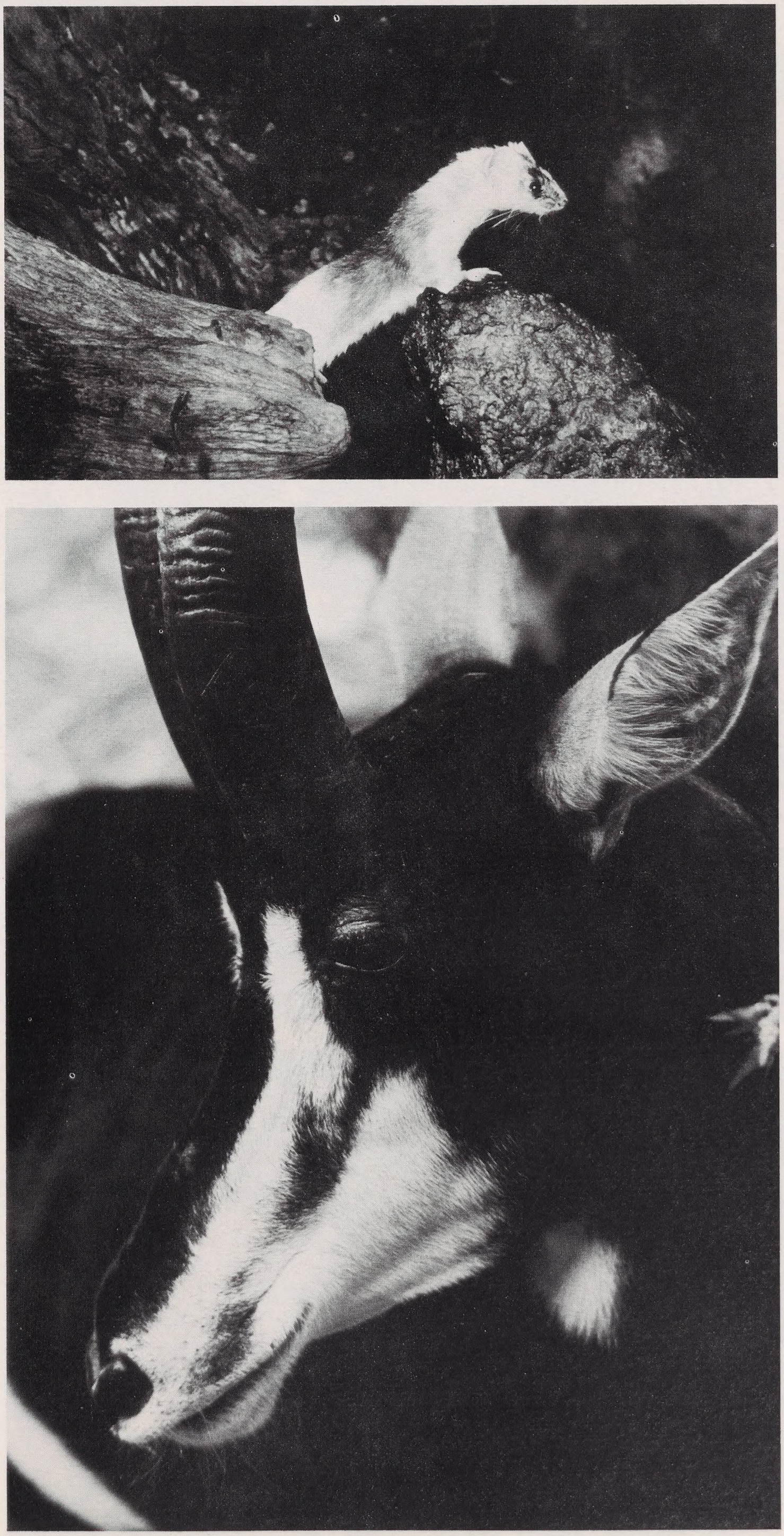
Above: The lichen spider (Pandercetes) *is well camouflaged on its habitat of tree trunks. Left: A crab spider* (Epicadus) *feeds on a fly. It is defended against its own predators by mimicking a flower.*

sophisticated predators may search for signs of symmetry when they are hunting camouflaged prey. In experiments, pigeons have been easily trained to detect symmetry; it would be surprising if wild birds could not do the same when they are searching for food.

In fact, a major predator response to prey camouflage may well be sharpened intelligence. When biologists speculate about why and how intelligence evolved, they are really wondering where and under what circumstances intelligence conferred a survival benefit to an animal. I think intelligence probably evolved first in the tropics, in response to the tremendous informational complexity found in tropical rainforests.

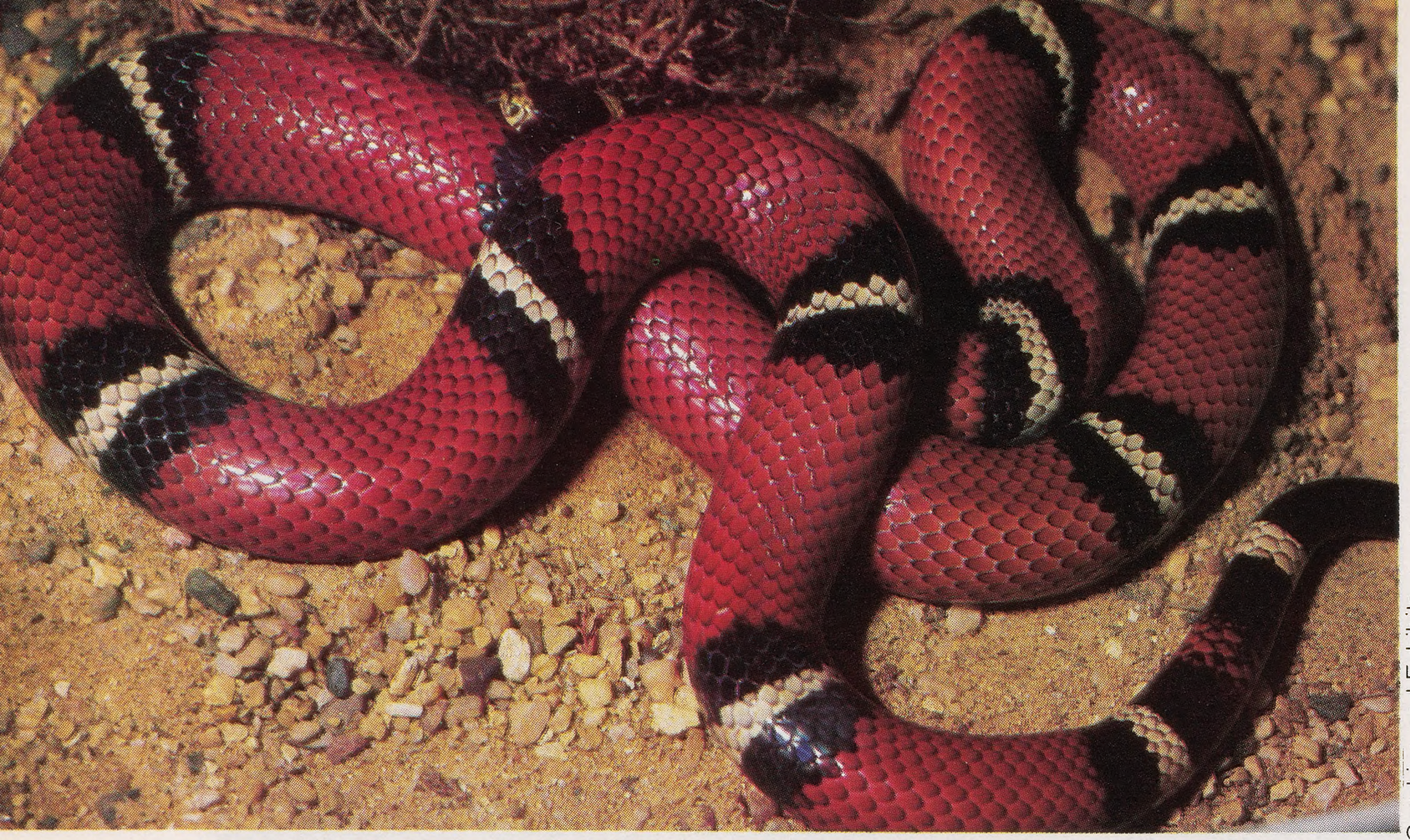
Tropical forests present an almost unbelievable amount of information that assails all of the senses. Of course, most animals use only a tiny fraction of this information in their daily lives to find food, shelter, mates and other necessities. But any piece of information that an animal can use to find more or better food than its rivals would give that animal an evolutionary edge. Where information about food, shelter, escape routes and so on is the most complex is precisely where it would be most advantageous either to have an enormous memory or the brainpower to learn common characteristics of a wide variety of objects.

It is easy to see how this increase in mental ability could have taken place in animals that hunted for insects in tropical



Milton Tierney

For several weeks in the fall and spring, the weasel (above) undergoes a gradual color change that provides white camouflage in winter and brown in summer. The disruptive patterns on the sable antelope (right) help conceal its outline.



Jessie Cohen, NZP Graphics and Exhibits

forests. Any animal that could break through such insect defenses as camouflage and mimicry would be onto a source of food not available to its less smart relatives. The monkey who learned that bilateral symmetry is an animal characteristic could use that "hypothesis" to find otherwise concealed food.

Just as the scientist learns the characteristics that unite many different animals under categories like "frog" or "insect," so the successful forest predator must learn common features that characterize "food." Much of what artificial intelligence tests measure is our capacity to recognize commonalities or differences. For our ancestors, and the ancestors of other predators, this was probably measured in survival. □

The harmless Sinoloan milk snake (top) wards off predators by mimicking the toxic coral snake, while the poisonous Gaboon viper (left) uses camouflage to hide from prey. Disruptive coloration conceals the ornate horned frog (below left). In typical hiding behavior, the young dorcas gazelle (below) crouches on a patch of earth that matches its color.

Milton Tierney

Double Jeopardy: The Gorilla Dilemma

Dr. Benjamin B. Beck

Despite years of determined efforts to preserve the world's largest primate, gorilla populations continue to decline. In the wild, these dignified and enigmatic animals are plagued by habitat destruction and poaching. In captivity, the causes of their decline are much harder to identify.

Currently, 550 gorillas live in the world's zoos and research centers. Their low birth rate—about 20 infants a year—is exceeded by their death rate, producing a net annual decline of three to five percent. In coming years, captive gorilla populations may decline even more rapidly because the best breeders—wild-caught gorillas—are aging and their reproductive output is dropping.

If the overall reproductive rate of the captive population does not increase, our children will have few gorillas to see in zoos. We cannot replenish dwindling zoo populations with wild gorillas; they are protected by the Convention on International Trade in Endangered Species. Legal exceptions to the Convention are rarely made because most zoos seem unable to manage and breed those gorillas they already have.

The six gorillas at the National Zoo (see sidebar, p. 14) have not reproduced since 1972. Their reproductive problems are typical of captive gorillas: With Nikumba and Tomoka, the causes are physiological; with Hercules and Sylvia, they are behavioral.

To understand these problems—and find solutions—we study the behavior and physiological status of our own gorillas and monitor the reproductive and social behavior of wild populations.

Like human females, female gorillas have a monthly sexual cycle. While human females are sexually receptive throughout the cycle, gorillas are receptive for only one or two days, during ovulation.

M'Wasi, Femelle and Sylvia all cycle and ovulate normally. NZP Chief Veterinarian Dr. Mitchell Bush and Reproductive Physiologist Dr. David Wildt have verified normal ovulation by a fiber optics technique called laparoscopy to directly examine the ovaries of the three females.

Evidence of normal cycling also came from Dr. William Lasley of the San Diego Zoo, who examined hormone concentrations in the females' urine. Keepers trained Femelle and M'Wasi to sit on a "potty" to provide a urine sample every morning for a month. The samples showed normal hormone patterns, with concentrations rising and falling predictably during a cycle.

Lasley has analyzed the urine of about 50 captive female gorillas, finding them all to be cycling normally. So we can rule out physiological abnormality in our females—and in female gorillas in general—as a cause of reproductive failure.

The picture is not as bright for males. In 1979, we surveyed North American zoos and found that less than 25 percent of adult male gorillas had reproduced in the two preceding years. Some did not have access to females, while many with access either did not copulate or failed to impregnate a female. Suspecting sterility, scientists examined sperm samples and found that about half the males had less than one percent normal sperm; most sperm were abnormally formed or inactive. Testicular atrophy was also evident in many of these males.

These results do not necessarily mean that half of all captive male gorillas are sterile, since the tendency is to examine only those males that are not reproductively successful. Still, it indicates widespread reproductive failure in captive gorillas, due in part to male sterility.

Sterility could have many causes, including repeated exposure to drugs, aging, obesity, chronic illness and stress. One sterile male resumed normal spermatogenesis after he was moved to a modern facility, introduced to unfamiliar females and placed on a strict weight-loss diet. Others

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NZP Primatologist Benjamin Beck has published numerous articles and books on primates and will soon be teaching a FONZ class, "Gorillas Under Glass."

©Polly McCann

Captive-bred gorillas, like this infant born at Chicago's Lincoln Park Zoo in 1978, are all too rare.

have remained sterile despite such changes.

Drs. Bush and Wildt have examined the ejaculates of the National Zoo's three male gorillas with discouraging results: Nikumba and Tomoka are sterile, even though they copulate. Hercules has normal sperm, but he does not copulate; his reproductive failure is rooted in behavioral, not physiological, abnormality.

In recent years, we have learned more about these problems from studies of gorillas in the wild. There are fewer than 50,000 wild gorillas left in the world. Of these, about 250 are mountain gorillas in Zaire, Uganda and Rwanda; some 4,000 are eastern lowland gorillas in Zaire; and 9,000 - 40,000 western lowland gorillas live in Nigeria, Cameroon, Equatorial Guinea, Gabon and westernmost Zaire and the Congo.

Mountain gorillas, the most intensely studied subspecies, live in groups of two to ten—an adult male leader, usually one to three adult females and their sexually immature offspring.

Other males are solitary, wandering in search of females. They sometimes engage in titanic fights with a group's leader. The males inflict serious wounds on each other, and the intruder sometimes tries to kill infants in the resident male's group. Females appear to assess the ability of males to protect them, their offspring and their food supply from other males. They may act on these assessments by leaving one male

©Jessie Cohen. NZP Graphics and Exhibits

Hercules is a favorite of young NZP visitors. But their children may not see gorillas in zoos, if the reproductive rate of the captive population does not increase.

and joining another.

This social system creates evolutionary selection for large male body size, huge canine teeth and robust crash helmet-like skulls, all advantageous as males fight to control females. The competition for control is a key to understanding gorilla reproduction. When one of "his" females becomes sexually receptive, a male gorilla does not have to compete with other males for copulatory access since he is the only partner at hand.

This contrasts with another African great ape, the common chimpanzee, whose social system creates evolutionary selection for male copulatory success, not for size. Chimps live in communities with many adult males who cooperate with each other in defending the community's territorial boundaries. No one male controls a female, and a female may copulate with many males during a single receptive period. Male chimpanzees compete reproductively not by fighting but by copulating as often as possible with receptive females. So there has been little selection for large body size and fighting ability among chimps: An adult male chimp weighs about 100 pounds compared to an average 340-pound adult male gorilla.

Selection for copulatory competition in the male chimpanzee, however, has resulted in a conspicuous penis, large scrotum, considerable ejaculate volume, high sperm count and testes that make up 0.269 percent of body weight. In contrast, the huge gorilla male has a diminutive penis and scrotum, testes that comprise only 0.017 percent of body weight and an ejaculate that barely fills a thimble. Moreover, this meager ejaculate contains fewer

(continued on page 14)

A Close Encounter

What do you do when a 400-pound gorilla charges you in the wilds of Africa?

"If a silverback male threatens by beating his chest and charging," our guide said, "just lie down and freeze. The charge is only a bluff."

I didn't have time to remember that advice when a huge male suddenly hurtled out of a nearby bamboo thicket and bounded directly at me. But the guide was right: The gorilla crashed by me within inches and disappeared in the forest as fast as he had appeared. The whole scene couldn't have taken five seconds; but the memory of it will last forever.

Few tourists have been able to watch gorillas close up in a natural setting. The animals are just too shy. Close-encounter safaris—including one planned for interested FONZ members—are possible at Rwanda's Volcano National Park because park guides visited three groups of wild mountain gorillas every day for almost a year, habituating the animals to humans. Now tourists can observe the gorillas without disturbing their natural daily routine.

Increased tourism revenues will help Park staff step up their campaign against poachers, whose wire snares caused the two largest gorillas in the group we observed each to lose a hand. Perhaps because of these injuries, the group I watched is unusual: All its members are males. But their playful roughhousing, our guide said, is typical gorilla activity.

Between us and the biggest or dominant male, two youngsters tumbled and played, ignoring us as they engaged in stop-and-go wrestling. They charged each other, thumped their chests, stood up and whacked each other with their hands, then grabbed and tumbled like wrestlers going for the winning pin.

Occasionally, the two largest males joined in—usually by a quick crash approach from the underbrush. Sometimes the big males thumped their chests and made harsh, staccato grunts.

Although the two youngest were too busy playing to eat, the older four munched wild celery or climbed bamboo trees to reach favorite tidbits.

As we sat in the jungle glade watching these antics, it was hard to believe that we were intimately observing daily routine in the life of totally wild gorillas. We were witnessing—without affecting—the eating, playing and interplay of the world's largest and rarest primates. Our presence was hardly noticed—as if we had been accepted as a natural, unthreatening part of their wild world.

—Sabin Robbins

Overleaf photo: Shortly before charging the photographer, this silverback mountain gorilla (background) rested peacefully with three youngsters. The most visible difference between mountain gorillas and NZP's lowland gorillas is the long, thick hair of the mountain-dwellers. (Photo by Sabin Robbins)

NZP's Gorillas

Nikumba, a 31-year-old wild-born male came to NZP at two years old. Now sterile, Nikumba has sired four viable offspring in 1961, 1964, 1967, and 1972. He is amiable, frequently allowing a female to dominate him; but he is assertive in halting aggression between females. He continues to copulate, although infrequently and only with M'Wasi.

M'Wasi, a 21-year-old wild-born female, is at NZP on loan from the New York Zoological Park. She had a stillborn offspring, delivered by Caesarean section, in 1973. Future births would probably also have to be by C-section. Although somewhat overweight, M'Wasi is an active, assertive female. She cycles normally and solicits and copulates willingly with Nikumba.

Jessie Cohen, NZP Graphics and Exhibits

M'Wasi

Tomoka, a 23-year-old male, was born at NZP to Nikumba and Moka, a female now deceased. Tomoka was separated from Moka within two hours of birth and was hand-raised. He is currently being treated for rheumatoid arthritis. Although sterile, he copulated for the first time in 1983 with Femelle.

Femelle, a 22-year-old wild-born female, came to NZP at three years old. She gave birth in 1972 to a male infant that was hand-reared due to apparent maternal mistreatment. Six months later, she had a miscarriage. The sire in both cases was Nikumba. Femelle is a competent and lively adult who cycles regularly. She no longer copulates with Nikumba, although she has copulated recently with Tomoka.

Hercules, a 19-year-old wild-born male, is on loan from the Baltimore Zoo, where he was raised with a female, "Sylvia." Hercules has never copulated, and receptive females do not solicit him. He is otherwise a healthy and magnificent male. Although he is incompatible with Sylvia, he can live with other females.

Sylvia, a 21-year-old wild-born female, is on loan from the Baltimore Zoo. She was hand-reared (with Hercules) with extensive human contact. Hercules and Sylvia became incompatible at maturity and were separated, each subsequently living alone for many years. Despite this history, Sylvia is now living with adult male and female gorillas. She is socially distant and subordinate, but she is social!

Gorillas *(from p. 11)*

than 20 percent viable sperm. (For comparison, a human male, with 50 percent viable sperm is not likely to impregnate a female.)

This may help explain why captive gorilla males are so prone to sterility, but it does not explain abnormality in their reproductive behavior. The clues to behavioral problems lie in the social structure of wild gorillas.

A baby gorilla is born into a complex social group. It is helpless at first, able reflexively to cling to its mother and suckle, but is otherwise dependent on maternal succor and paternal protection. Within a year, it is making short forays from its mother to explore its physical and social world. It interacts increasingly with others in its social group. The males, who can be ferocious fighters, are gentle and indulgent fathers. They willingly suffer and seem to enjoy their youngsters climbing on their heads, pulling their hair and stealing food from their cavernous mouths.

At sexual maturity (about age 8 for females and 11 for males), gorillas leave the group into which they were born. Most males initially become solitary while females seek to join other groups. The immediate causes of emigration are unknown, but by leaving their natal group they decrease the likelihood of inbreeding.

Years ago, when large numbers of wild-caught gorillas were being exported from Africa, it was common for zoos to acquire one infant of each sex. Adults were too difficult to capture and ship, so they often were shot and their helpless infants taken for export.

As they grew, the two lovable and healthy infants were inseparable, moving from the zoo director's home to an engaging zoo

nursery, and finally to the ape house. But at sexual maturity, they could not emigrate, as they would have done in the wild. Instead, the female would prove reluctant to copulate with the male of her natal "group." As he gained adult size, becoming larger and heavier than she, he would begin to abuse her when she refused to copulate, and ultimately they would have to be separated.

When zoos learned from field research about the natural process of emigration at maturity, they began to seek unfamiliar mates for these "incompatible" gorillas. The results were usually dramatic. Within hours of introduction to an unfamiliar partner, the gorillas would sometimes copulate for the first time in their lives. Some of these animals have become prolific breeders.

This simple solution, which exemplifies the interplay between field research and captive management, worked only if the youngsters were old enough (about 18 months) at capture to have socially identified with their gorilla mothers and group members. Very young infants, having missed the social richness of a natural group before their capture, identified not with other gorillas but with their human caretakers. As adults, they directed social and sexual responses toward people.

At the National Zoo, Sylvia and Hercules appear to embody these problems. Their ages at capture are not precisely known, but they were infants. They were raised in a home by solicitous humans; they became incompatible at maturity and were separated.

Intense hand-rearing and extended solitary caging have produced in Sylvia and Hercules dramatic behavioral abnormalities. During ovulation, Sylvia masturbates or sexually solicits humans, never gorillas. Neither she nor

Jessie Cohen, NZP Graphics and Exhibits

NZP Veterinarians Lindsay Phillips (left) and Bush examine the anesthetized Sylvia.

Jessie Cohen, NZP Graphics and Exhibits

Born at NZP, 23-year-old Tomoka is sterile.

It has taken us a year of research to learn what the gorillas apparently already knew: Hercules is not very attractive to gorilla females and Sylvia is a wallflower.

Hercules is known to have copulated, and Sylvia has stereotypic hand motions with high rates of regurgitation-reingestion. This curious behavior occurs primarily in captive gorillas that were separated early from their mothers, according to NZP Curator of Mammals Dr. Edwin Gould, who is studying its causes and prevention.

This year, Sylvia and Hercules were finally socialized enough to live with other gorillas, but they have little interaction within their groups. For example, one index of gorilla sociability is how often they approach and sit down next to each other—a behavior called "*rest near.*" The NZP primate staff and FONZ behavior watchers scored the frequency of *rest nears* during the four months that Sylvia lived with M'Wasi, Femelle and Nikumba. Sylvia never rested near the other three and only once did one of them (Femelle) rest near Sylvia. In contrast, the closely bonded M'Wasi and Nikumba were seen resting near each other 58 times.

During the same four-month period, Femelle spent 65 percent of the time in the same cage as Nikumba. But when Femelle lived in a group that included Hercules, she spent only 20 percent of the time in the same cage with Hercules.

It has taken us a year of research to learn what the gorillas apparently already knew: Hercules is not very attractive to gorilla females and Sylvia is a wallflower. Their reproductive failure is behavioral, induced ironically by well-meaning zoo folk.

The failure of Nikumba and M'Wasi, on the other hand, is physiological: M'Wasi sexually solicits Nikumba (but not Hercules or Tomoka) and copulates only with Nikumba. But he is sterile, and even if she became pregnant, she would probably have to deliver by Ceasarian section because of her 1973 C-section. This would increase the likelihood that her infant would have to be hand-raised—thus predisposing it to yet another cycle of behavioral deficit.

Sometimes I wish I were Dr. Frankenstein, able to graft Nikumba's behavior with Hercules' physiology, and M'Wasi's coquettish drive with Sylvia's reproductive tract.

We might try to artificially fertilize our healthy females with sperm from a proven male, recognizing that we would probably have to hand-raise the offspring. Two gorillas have already been born in other zoos by artificial insemination, but this route is stressful and costly. We might send Femelle and M'Wasi to other zoos to be bred, and send Sylvia elsewhere to gain social experience with younger gorillas, but this would detract from our exhibition program and leave Nikumba without his favored M'Wasi. As we make these decisions, we must balance captive propagation success with the welfare of our six complex and fascinating gorillas. □

Jessie Cohen, NZP Graphics and Exhibits

Femelle (right) sits near Nikumba, a behavior that zoologists use to measure gorilla sociability.

California Sea Lions: A Report From the Field

Sara Iverson

Last August, the National Zoo's Handrearing Facility received a baby sea lion who was unable to suckle from its mother. Several years ago, the pup's chances of survival would have been slim. Pinnipeds—the order that includes seals and sea lions—were once difficult to hand-rear. Standard milk formulas did not provide adequate nourishment, and no one was sure how much or how often to feed pinniped pups.

Today, as a result of nutritional and behavioral research, zoos can successfully handrear young pin-

(continued on next page)

From a blind, NZP researchers observe natural behavior on the beaches where sea lions gather to pup and mate.

Sea Lions *(from page 17)*

nipeds. Last year, using information from a FONZ-supported study of the California sea lion, the Zoo's Nutrition Laboratory devised a formula for the handreared pup that closely resembled its mother's milk. The study also told handrearing volunteers the pup's proper daily intake and expected growth rate.

A joint project of the Zoo's Nutrition Lab and Department of Mammalogy, the study is useful not only to nutritionists and zoo handrearers, but also to zoologists and naturalists. Pinnipeds are of particular interest to animal nutritionists because their milk is extremely high in fat and calories. Zoologists and naturalists are especially interested in pinniped "maternal investment"—the amount of time, energy and physiological resources the female expends as her pup develops.

Sara Iverson, a FONZ research assistant who has worked on the sea lion study since it began in 1981, sent the following report from her rocky outpost 68 miles off the California coast:

SAN NICOLAS ISLAND, CA

There is a pristine beauty about the windswept moonscape of San Nicolas. We call it "Arizona in the ocean"—32 square miles of sand, desert shrubbery and rocks. Owned by the U.S. Navy, San Nicolas is off limits to the public and offers much support to biological research. A haven for three species of breeding marine mammals, the island is a major rookery for the California sea lion, elephant seal, harbor seal and, most recently, two to three individuals of the Guadalupe fur seal.

We are here to study California sea lions. One of the greatest rewards of doing field research with these animals is witnessing the marvel of their birth and development—from the moment a fluid-covered head appears and the newborn pup calls and climbs on its mother, to the day, several months later, when the pups begin frollicking together in the surf.

Our major focus is on these pups' nutrition and growth. All mammals nourish their young with milk. But among species, there are wide variations in the composition of milk, the pattern and length of lactation, the suckling patterns of the young and the amount of milk they consume. Animal nutritionists study these differences to learn how they affect the growth rate and development of young mammals.

We selected the California sea lion because it exhibits the characteristic high-fat milk and long lactation period of *Otariids,* the pinniped family comprised of sea lions and fur seals or eared seals.

There could be several explanations for the high-fat milk of pinnipeds. Seal and sea lion pups, living in wet and often very cold environments, have high energy needs that could require a large intake of extremely concentrated milk. Alternatively, perhaps by packing all the nutrients into highly concentrated milk, the female may secrete less volume and thus conserve her own body water, which is important in a salt water environment. This concentration of nutrients may also allow the female to carry less milk in her mammary glands during the long intervals (several days in certain species) between suckling bouts.

To study the sea lions' behavior, we set up a blind overlooking an undisturbed cove on the island. From the blind, we observe seasonal changes in behavior, especially attendance and feeding patterns of females, suckling and activity patterns of pups and behavioral development of pups from birth to weaning.

During the winter months, the adult males and females are usually out at sea; the rookeries (beaches where sea lions gather to pup and mate) are empty but for a

Once his territory is established, a male defends it fiercely, not even leaving to feed until the end of the breeding season.

few yearlings and young males. Then, in the last week of May and first week of June, many females haul out onto the beaches. The large adult males arrive shortly thereafter to establish territories where females have congregated. Once his territory is established, a male defends it fiercely, not even leaving to feed until the end of the breeding season in late July.

Most females deliver single pups during the first two weeks of June. They usually breed again a few weeks after they give birth. When their pups are a week old, the females begin cyclical feeding trips, leaving for several days and returning to suckle their pups for a day or two. This pattern continues until the pups are weaned. Feeding trips last longer and longer as the pups get older. In the females' absence, the pups play together in large pods. After they are about a month old, the pups become more mobile and spend more time swimming in shallow tide pools.

From June through late fall, we collected milk, determined milk intake of pups, examined milk digestion and measured growth. To collect milk, a marine mammal veterinarian immobilized a lactating female with a small dart containing enough drug to make her groggy. Milk was taken from the teats manually using firm pressure to get through the thick layer of blubber. Blood samples and weights were also taken and each female was held captive until she had fully recovered. Milk samples were frozen and sent to the National Zoo for analysis of fat content, protein, sugar, vitamins and minerals. In the early stages of lactation the milk is very high in fat—about 33 percent—and becomes even richer as the pup gets older.

The next focus of our nutritional work was on the pup's milk intake and growth. This task was complicated by the fact that the little black pups are indistinguishable from one another. To monitor an individual pup over several months, we marked them, either by making a blond letter in their fur with commercial hair bleach or by dabbing small dots of flourescent paint on them.

Using a stomach tube, a researcher takes a sample of digested milk from an immobilized pup. Dabs of flourescent paint on the pup's head identify it for subsequent monitoring.

To estimate how much milk a pup had consumed over several weeks, a known amount of heavy water was given through a stomach tube. Subsequent blood samples, taken every five days for three weeks, were then analyzed for the dilution of this isotope to give us an estimate of how much milk had been ingested by the pup between blood samples. At each recapture we recorded changes in the pup's weight, body length, girth and front and rear flipper lengths.

We also studied the pups' digestion and absorption process to learn how they digest such a high-fat milk, how they use its various nutrients and how they deposit the thick layers of blubber under their skin.

By combining our nutritional studies with information on the behavior of mothers and pups and on sea lion reproductive cycles, we can gain a comprehensive picture of sea lion lactation, maternal investment and pup development. By comparing these patterns with those of other species, we can begin to understand reproduction and lactation in mammals. Ultimately, the knowledge can be applied to the proper care and management of both captive and wild sea lion populations, in an effort to help ensure the survival of this remarkable species. □

What's new at the Zoo?

A Croc of Joy

For almost a decade, the Zoo has tried to breed its endangered Cuban crocodiles. Last August, amid excitement in the herptile world and fanfare in the national press, we were successful.

Our seven offspring are the first crocodiles ever hatched at the National Zoo, and we are only the third institution in the U.S. to hatch the rare Cuban crocodile. Fewer than 100 of these reptiles live in zoos around the world.

The breeding success resulted from years of careful planning, good husbandry by NZP's Department of Herpetology and a cooperative agreement with the Wilhelma Zoological Park in Stuttgart, West Germany.

Ever since four Cuban crocodiles arrived at NZP in 1975, the male has tried to breed with the three females. But the females produced no eggs. In 1981, a fourth female, larger than the other three, arrived on breeding loan from the Wilhelma Zoo. Two years later, she produced several eggs that were found broken in the exhibit pool.

During the spring of 1984, the crocodiles mated often and the Stuttgart female's eggs, artificially incubated, hatched after 10 weeks.

The seven-inch hatchlings are growing at a rate of two inches a month, and will reach adult lengths of six to nine feet. Their parents now measure about seven feet long.

At one year old, when the hatchlings can be sexed, three will go to the Wilhelma Zoo. Some of the remaining four may be traded to other zoos. The NZP Department of Herpetology hopes to keep at least one male from the hatchlings.

Found in the wild only in Cuba, the Cuban crocodile became endangered through hunting for skins and meat, the conversion of wetlands to agricultural use, and interbreeding with American crocodiles. During the early 1960s, Cuban crocodiles *(Crocodylus rhombifer)* and American crocodiles *(Crocodylus acutus)* were collected for a newly established crocodile farm in Cuba's Zapata Swamp. These two species began interbreeding at the farm, producing hybrids that rarely occur in nature because the American crocodile normally inhabits brackish and salt water while its Cuban cousin prefers freshwater.

Because of the shrinking natural population and concern that Cuban crocodiles might hybridize themselves out of existence, they have been considered endangered for well over a decade. But recent measures taken by the Cuban government offer hope for the future. Wild populations have reportedly reestablished themselves in protected areas of the

Jessie Cohen, NZP Graphics and Exhibits

NZP's Cuban crocodile hatchlings made headlines because zoos have fewer than 100 of these endangered reptiles.

Jessie Cohen, NZP Graphics and Exhibits

America's largest land mammal has returned to the National Zoo.

Zapata Swamp; a small population apparently exists on the Isle of Pines; and Cuba now has a breeding farm stocked with "pure" Cuban crocodiles. So management of a captive population in U.S. zoos may be more important for research, education and exhibition than for conservation.

The breeding of NZP's Cuban crocodiles was a happy event that has broader implications than merely raising cute baby crocodiles. It has emphasized the serious nature of zoo breeding programs, the importance of developing species management programs with other zoos and the value of cooperation and planning in the conservation of captive species.

—Michael Davenport
NZP Department of Herpetology

Welcome Back Bison

American plains bison have returned to the National Zoo after almost a 20-year absence.

The two females, aged 13 and 18, are descended from the 60 million bison that once roamed the Great Plains of North America. During the 19th century, America's largest mammal species was nearly slaughtered into extinction for food, sport and grazing land. Entire herds were shot in the 1860s to clear the way for transcontinental railroads. By the end of the century, fewer than 1,000 bison remained.

Today, because of captive-breeding and reintroduction programs led by the Bronx Zoo and the American Bison Society, bison are flourishing.

In 1888, the Smithsonian Institution kept two bison on the Mall as part of its department of living animals. The next year, department head William Hornaday transferred his unusual assortment of creatures to a quiet valley overlooking Rock Creek and so began the National Zoo.

The bison pair became one of the Zoo's first exhibits and a long-time passion for Hornaday. In 1905, as director of the Bronx Zoo and the American Bison Society, he was instrumental in bringing national attention to the plight of bison.

Welcoming the bison, Michael Robinson, Director of the National Zoo, said, "We are extremely pleased to exhibit once again an animal that plays such an important role in the history of the Zoo and America as well. It reminds us of the Zoo's founding mission, which is still current: to help save endangered species from extinction."

—Elizabeth Brett

Help Beautify the Zoo's Flight Cage

The Zoo needs donations of small evergreen shrubs and ground cover (i.e., periwinkle, pachysandra, ferns, holly, juniper, yews, azaleas, rhododendron) for its Flight Cage. To donate plants, please call the NZP Greenhouse at 673-4719.

FONZ Report

1984 brought exciting changes and fresh directions to FONZ as well as to the National Zoo and the Smithsonian Institution, of which the Zoo is a part. As a first step in charting future directions, FONZ's Board of Directors, past Board officers and executive staff participated in a two-day planning session last September. Discussion focused on how to fulfill FONZ's potential, meet the needs of an increasing membership and continue to strengthen the cooperative effort between FONZ and the National Zoo.

The fruitful meeting was particularly timely because the Zoo and the Smithsonian, both under new leadership in 1984, are also taking a fresh look at future goals and plans. Theodore H. Reed, the Zoo's Director for 28 years, retired and was replaced last January by Dr. Michael H. Robinson, previously the Deputy Director of the Smithsonian Tropical Research Institute.

S. Dillon Ripley, Secretary of the Smithsonian for 20 years, also retired last year. His position was filled by Dr. Robert McCormick Adams, an archaelologist and anthropologist known for his extensive research into ancient Middle Eastern civilization.

New leadership combined with FONZ's tremendous membership growth offers exciting opportunities for the future.

ZooFari

Last May, FONZ hosted its first National ZooFari, a gourmet dinner-dance evening to benefit the Theodore H. Reed Animal Acquisition Fund. The Fund will help the Zoo acquire and breed exotic and endangered species. The 1984 ZooFari was such a success that FONZ plans to make it an annual event. The 1985 ZooFari is scheduled for May 16. It will feature an Asian theme, and the door prize will again be two round trip tickets on World Airways' ultra-class service to Honolulu, Los Angeles, San Francisco, Kansas City, New York or Frankfurt.

Naltchayan

The first National ZooFari was such a success that FONZ will do it again on May 16, 1985. Enjoying the 1984 gala are, left to right: retired NZP Director Theodore Reed, former FONZ President Robert Nelson, Joan Manton and FONZ Board member John Manton.

Olmsted Walk

1985 will also see groundbreaking for the Zoo's three-year master plan to redevelop Olmsted Walk. Along with the walk's new and improved animal exhibits, FONZ plans to renovate and expand its visitor service facilities.

Board of Directors

Dr. Roscoe M. Moore, Jr., Senior Veterinarian and Epidemiologist for the Commissioned Corps of the U.S. Public Health Service, was elected President of the FONZ Board of Directors for a one-year term. A FONZ Board member for five years, Moore has served as Chairperson of the Visitor Services Committee, Co-chairperson of the National ZooFari Benefit Commit-

tee and member of the FONZ Executive Committee.

Other officers elected for a one-year term are: William C. Bryant, First Vice President; Janice A. Booker, Second Vice President; George A. Didden, III, Treasurer; and Sylvia L. Samenow, Secretary.

New members of the Board elected for three-year terms are: John O. Goldsmith, Merrill Rose and Louis I. Rosen. Re-elected Board members are: Anne Webster Hamilton; William Duncan Hawkins, III; Robert W. Mason; Monica J. Morgan; and James F. Rogers. □

SUNDAY AFTERNOONS AT THE ZOO

- Wildlife Films
- Live Performances
- Informative Talks
- Workshops

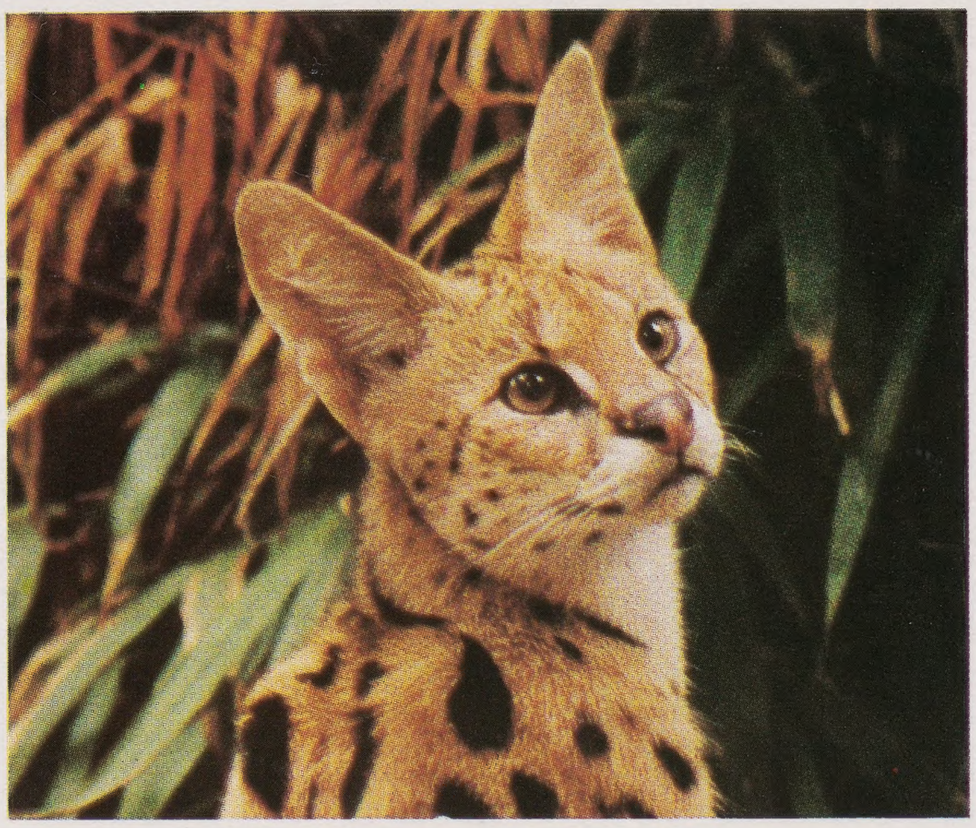
Place: Education Building (near the Connecticut Avenue entrance)

Time: 1:00-3:00 p.m., winter Sundays

Cost: Free (Zoo parking, $3)

Phone: 673-4717

Anne Gravely



How to Help Yourself And the Animals!

At a time when wildlife conservation is more important than ever, greater demands are being made on FONZ resources. Without our help, *your* National Zoo cannot fully carry out the research, breeding, and education programs designed to ensure survival for many rare and endangered species otherwise doomed to extinction.

If you would like to help, but face current commitments such as children in school and a mortgage, please consider a deferred giving plan. Through deferred giving, you can be a modern-day Noah and even give yourself significant income and estate tax benefits.

To receive a brochure describing the many ways FONZ can help you establish a deferred giving plan, please call the Office of the Executive Director, 202/673-4950.

Jobs at the Zoo!

FONZ needs dependable, enthusiastic employees for all of its visitor services staffs (gift shop, parking, and stroller rental cashiers; food preparation, service, and sales; traffic and information aides; and grounds cleanup crew) during their busy seasons—spring, summer, and early fall.

If you, family members, or friends (age 16 and over) have four or five days free each week and would like to work at our beautiful National Zoo during some or all of these seasons, please call FONZ Personnel, 673-4970, weekdays 9 to 4 *soon*, and request a seasonal jobs brochure and application.

As you know, FONZ and the National Zoo are super special. Your help will be special, too.

The endangered Cuban crocodile is flourishing at the National Zoo, where seven healthy hatchlings are the pride and joy of the Reptile House (p. 20).

Friends of the National Zoo
National Zoological Park
Washington, D.C. 20008

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